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Semi-interpenetrating network composites of poly(lactic acid) with *cis*-9-octadecenylamine modified cellulose-nanofibers from *Areca catechu* husk

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ABSTRACT

- Poly(lactic acid)/cellulose-nano fiber (PLA/CNF) composites were prepared with CNF synthesized from the areca husk fibers (AHF) by TEMPO-mediated oxidation for the first time
- and the properties were evaluated. MCNF synthesized by the controlled amidation of CNF with
- 4 cis-9-octadecenylamine (OA) resulted in PLA/MCNF composites with higher mechanical
- 5 properties and tunable elongation compared to PLA/CNF. It was shown that the tensile
- 6 properties can be further improved with induced cross-linking at melt processing conditions
- 7 using dibenzoyl peroxide (DBP) in PLA/MCNF/DBP. The increased elongation observed with
- 8 higher MCNF content showed the possibility for control on brittleness in these transparent nano
- 9 composites. The higher modulus and thermal stability observed in the cross-linked composites
- with 2 % MCNF and 2 % DBP attributed to the formation of semi-interpenetrating network
- 11 (SIPN) by in situ cross-linking evidenced by SEM and TEM observations. DSC analysis of cured
- 12 composites showed lowering of Tg with MCNF incorporation which may be attributed to the
- increased segmental mobility of PLA due to reduced interface by cross-linking. DMA analysis
- showed the better compatibility of the MCNF with the PLA matrix in SIPN attributed to the long
- alkyl chain modification. The increase in modulus with a negative shift in the tan \square peak
- position further supported the cross-links in SIPN. These SIPN showed transparency to visible
- light and a very low water absorption of 1.5 % compared to 7 % for virgin PLA. These green
- 18 composites with tunable flexibility, modulus and better thermal stability showed prospects for
- 19 applications as transparent eco-friendly food packaging material.
- 20 Keywords: Bionanocomposite, Poly(lactic acid), Natural fiber, Cellulose nanofiber, Semi-
- 21 interpenetrating Network.
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24 1. Introduction

- Green composites of degradable polymers with natural fibers are important as packaging
- 26 films concerning the environmental problems associated with commodity plastics which are

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